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ABSTRACT

The proposed theoretical framework emphasizes the interaction between sociocultural, linguistic, and school program factors in explaining the academic and cognitive development of bilingual children. It is theorized that bilingualism that is cognitively and academically beneficial can be achieved only on the basis of adequately developed first language (L1) skills. This position is based on two hypotheses. The "developmental interdependence" hypothesis proposes that the development of competence in a second language (L2) is partially a function of the type of competence already developed in L1 at the time when intensive exposure to L2 begins. The "threshold" hypothesis proposes that there may be threshold levels of linguistic competence that bilingual children must attain both in order to avoid cognitive disadvantages and to allow the potentially beneficial aspects of bilingualism to influence their cognitive and academic functioning. This model of bilingual education explains educational outcomes as a function of the interaction between background, child input, and educational treatment factors. Attention is also directed to problems with bilingual education program evaluations that fail to consider these potential interactions. A review of relevant literature and studies is included. (Author/SW)

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LINGUISTIC INTERDEPENDENCE AND THE EDUCATIONAL DEVELOPMENT OF BILINGUAL CHILDREN

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ABSTRACT

The central thesis of this paper is that a cognitively and academically beneficial form of bilingualism can be achieved only on the basis of adequately developed first language (L1) skills. Two hypotheses are formulated and combined to arrive at this position. The "developmental interdependence" hypothesis proposes that the development of competence in a second language (L2) is partially a function of the type of competence already developed in L1 at the time when intensive exposure to L2 begins. The "threshold" hypothesis proposes that there may be threshold levels of linguistic competence which a bilingual child must attain both in order to avoid cognitive disadvantages and allow the potentially beneficial aspects of bilingualism to influence his/her cognitive and academic functioning. These hypotheses are integrated into a model of bilingual education in which educational outcomes are explained as a function of the interaction between background, child input, and educational treatment factors. It is suggested that many evaluations of bilingual education programs have produced uninterpretable data because they have failed to incorporate the possibility of these interactions into their research designs.

LINGUISTIC INTERDEPENDENCE AND THE EDUCATIONAL DEVELOPMENT OF BILINGUAL CHILDREN*

James Cummins

Why does a home-school language switch result in high levels of functional bilingualism and academic achievement in middle-class, majority-language children (Cohen, 1974; Davis, 1967; Lambert and Tucker, 1972; Swain, 1978a), yet lead to inadequate command of both first (L1) and second (L2) languages and poor academic achievement in many minority-language children (United States Commission on Civil Rights, 1975; Skutnabb-Kangas and Toukomaa, 1976)? This question has been considered in several recent papers (Bowen, 1977; Cohen and Swain, 1976; Paulston, 1978; Swain, 1978b; Tucker, 1977) and the marked difference between the outcomes of immersion programs for the majority child and "submersion" programs for the minority child has usually been attributed to sociocultural and attitudinal factors such as socio-economic status (SES), community support for the school program, relative prestige of L1 and L2, and teacher expectations. Unlike earlier attempts to explain the poor academic achievement of many minority language children, little importance has generally been attributed to specifically linguistic explanatory factors. Bowen (1977) goes so far as to argue that linguistic factors are unimportant and that "...the choice of language of instruction in

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our schools is linguistically irrelevant..." (p. 116).

In contrast to this position, I shall propose a theoretical framework that assigns a central role to the *interaction* between sociocultural, linguistic, and school program factors in explaining the academic and cognitive development of bilingual children. The paucity of meaningful data on the effectiveness or otherwise of bilingual education can be largely attributed to the fact that evaluations have ignored this interaction. Before the interactions between these sets of factors are considered, previous hypotheses regarding the individual role of each will be briefly reviewed.

LINGUISTIC FACTORS

Early attempts to explain the poor academic achievement of many minority language children tended to attribute a major role to linguistic explanatory factors. A frequent finding was that bilingual children performed poorly on the verbal parts of intelligence tests as well as on academic tasks, and several investigators argued that bilingualism itself was a cause of "mental confusion" and "language handicaps" (Darcy, 1953; Peal and Lambert, 1962). Perhaps the most coherent theoretical statement in this genre was Macnamara's (1966) "balance effect" hypothesis which proposed that a bilingual child paid for his/her L2 skills by a decrease in L1 skills.

A somewhat different attempt at explanation is the hypothesis that mismatch between the language of the home and the language of the school leads to academic retardation (Downing, 1974;

UNESCO, 1953). The "linguistic mismatch" hypothesis is exemplified in the well-known UNESCO statement that "it is axiomatic that the best medium for teaching a child is his mother tongue" (UNESCO, 1953, p. 11). On the basis of his study of bilingualism in Irish primary schools, Macnamara (1966) also argued that instruction through the medium of a weaker language led to retardation in subject matter taught. Assumptions similar to those of the "linguistic mismatch" hypothesis underlay much of the impetus for the development of bilingual education in the United States.

However, recent research points clearly to the inadequacy of both the "linguistic mismatch" hypothesis and the hypothesis that bilingualism itself is a source of academic and cognitive retardation. A large number of recent studies suggest that, rather than being a cause of cognitive confusion, bilingualism can positively influence both cognitive and linguistic development (Cummins, 1976, 1978b). In addition, the well-documented success of immersion programs for majority language children is clearly inconsistent with any simplistic notion that linguistic mismatch *per se* causes academic retardation.

In view of the obvious inadequacy of simplistic linguistic explanations of the minority child's academic difficulties, it is not surprising that as educators reexamined the assumptions underlying bilingual education, they have emphasized sociocultural and school program variables rather than linguistic factors.

SOCIO-CULTURAL FACTORS

Two recent reviews (Bowen, 1977; Tucker, 1977) of linguistic perspectives on bilingual education have argued forcefully for the primacy of social factors over specifically linguistic or pedagogical factors in explaining the academic progress of bilingual children. Both Bowen and Tucker reject the generality of the "vernacular advantage theory" on the basis of the high levels of academic and linguistic skills attained by children in immersion programs. Bowen (1977) states that:

> ...what really confirms for me the thesis that the choice of language to be used as medium of instruction is not the determining factor of pedagogical success is the availability of counterevidence, experiments where students studying in a second language matched or excelled over those studying in their mother tongue. This would not be expected to happen if Macnamara's "balance effect" operates. (p. 110-111)

Bowen goes on to argue that the choice of medium of instruction "...should be determined by social conditions--not by a preconceived notion that the mother tongue should *per se* be used" (p. 113).

Tucker's (1977) conclusion is similar. He argues that:

> ...social, rather than pedagogical factors will probably condition the optimal sequencing of languages. Thus, in situations where the home language is denigrated by the community at large, where many teachers are not members of the same ethnic group as the pupils and are insensitive to their values and traditions, where there does not exist a pressure within the home to encourage literacy and language maintenance, and where universal primary education is not a reality it would seem desirable to introduce children to schooling in their vernacular language...Conversely, in settings where the home language

> is highly valued, where parents do actively encourage literacy and where it is "known" that the children will succeed, it would seem fully appropriate to begin schooling in the second language. (p. 39-40)

Bowen and Tucker are undoubtedly correct both in rejecting axiomatic statements regarding the medium of instruction and in assigning a fundamental causal role to social factors. As Paulston (1976) and Fishman (1977) point out, the effects of bilingual education programs can be understood only when these programs are regarded as the result of particular constellations of societal factors rather than as independent variables in their own right.

SCHOOL PROGRAM FACTORS

Although immersion and submersion programs both involve a home-school language switch, in other respects they are quite dissimilar (Cohen and Swain, 1976; Swain, 1978b). In immersion programs all students start the program with little or no competence in the school language and are praised for any use they make of that language. Children in submersion programs, on the other hand, are mixed together with students whose L1 is that of the school and their lack of proficiency in the school language is often treated as a sign of limited intellectual and academic ability. Children in submersion programs may often become frustrated because of difficulties in communicating with the teacher. These difficulties can arise both because the teacher is unlikely to understand the child's L1 and also because of different culturally-determined expectations of appropriate behavior. In contrast, the immersion teacher is familiar with the child's lan-

guage and cultural background and can therefore respond appropriately to his/her needs. The immersion child's L1 is never denigrated by the teacher and its importance is recognized by the fact that it is introduced as a school subject after several grades. The L1 of the minority-language child, on the other hand, is often viewed as the cause of the child's academic difficulties and an impediment to the learning of L2. Consequently, those aspects of the child's identity that are associated with his/her L1 and home culture are seldom reinforced by the school.

In general, what is communicated to children in immersion programs is their success, whereas in submersion programs children are often made to feel acutely aware of their failure. Thus, as Swain (1978b) points out, despite their superficial similarity, immersion and submersion programs are clearly different programs and it is not surprising that they lead to different results.

THE NEED FOR A THEORETICAL FRAMEWORK

It is clear that there is no shortage of explanatory variables to account for the different outcomes of immersion and submersion programs. However, what is lacking is a coherent framework within which the relative importance of different variables and the possible interactions between them can be conceptualized. While sociocultural background factors are obviously important, we do not know what are the links in the causal chain through which their effects are translated into academic outcomes. Similarly, we have very little idea of the mechanisms through which many school program variables affect outcomes. To take the obvious example

(despite ten years of widespread bilingual education), there is no consensus as to the relative merits of ESL-only, transitional bilingual, or maintenance bilingual programs in promoting academic and cognitive skills. There are, in fact, very few interpretable data that are directly related to this central issue.

One of the main reasons for the lack of meaningful research is that evaluators of bilingual education programs have failed to incorporate the possibility of interaction between educational treatment and child input factors into their experimental designs. Not surprisingly, therefore, there has been little consideration of the possibility that inconclusive or ambiguous results may be a function of this interaction. Normally, in order to assess the effects of an experimental program, an evaluator will attempt to ensure (either through matching or covariance analysis) that experimental and control groups are equivalent in terms of background experience and pre-test scores. Where program entrants are heterogeneous with respect to any relevant traits, the evaluator will normally take account of possible aptitude by treatment interactions. In evaluations of Canadian immersion programs, a variety of possible aptitude by treatment interactions has been investigated in depth, despite the relative homogeneity of program entrants (Bruck, 1978; Genesee, 1976; Trites, 1976). However, in the United States where there is enormous diversity within different groups of minority-language children in terms of motivational, cognitive, and linguistic characteristics, evaluations have taken little or no account of possible interactions between these child input factors and educational treatments.

In order for evaluations to incorporate the possibility of interaction between child input and educational treatment variables, it is necessary to specify the relevant child input variables and develop a framework within which school outcomes can be meaningfully related to this interaction. In other words, one must consider the dynamics of bilingual children's interaction with their educational environment if any answer is to be found to the central question of whether or not the academic progress of children of limited English-speaking ability will be promoted more effectively if initial instruction is in their L1. It is insufficient to specify merely the regularities between academic outcomes and both societal and program inputs without pursuing the connecting links in the causal chain.

The roles of two main child input factors will be examined in this paper. These are (1) conceptual-linguistic knowledge, and (2) motivation to learn L2 and maintain L1. These factors are conceived as intervening variables that interact with school program factors and mediate the effects of more basic sociocultural background factors on cognitive and academic outcomes. Before outlining this framework in detail, it is necessary to justify the inclusion of a linguistic factor as a critical child input variable and explain what is meant by "conceptual-linguistic knowledge."

LINGUISTIC FACTORS REVISITED: LANGUAGE AND THOUGHT IN THE BILINGUAL CHILD

Paulston (1978) points out that there has been little exploration of the relationships between language and cognition

in the context of United States bilingual education programs. For example, the United States Commission on Civil Rights (1975) report contains no reference to empirical work on cognitive development of children in bilingual programs. The argument advanced in this report amounts essentially to a restatement of the linguistic mismatch hypothesis. For example, the report states that:

> When language is recognized as the means for representing thought and as the vehicle for complex thinking, the importance of allowing children to use and develop the language they know best becomes obvious. (United States Commission on Civil Rights, 1975, p. 44)

As pointed out earlier, this argument fails to account for the absence of any negative effects on the linguistic and cognitive development of children in immersion programs.

Paulston (1978) also points out that another current approach to the topic of language and cognition in the bilingual child is to dismiss the issue with vague comments on the invalidity of the instruments and procedures used in early studies. The educational difficulties of the minority child are then attributed to non-linguistic background or school program factors. Related to this approach are reviews that point to the fact that early studies of bilingualism and IQ were poorly controlled and that more recent studies have reported cognitive advantages associated with bilingualism (Iiams, 1976; Merino, 1975; Ramírez *et al.*, 1977). "Bilingualism" is then conceived as a positive force in intellectual development that fails to materialize in minority language situations because of socio-economic or educational conditions. However, this approach is usually characterized by uncritical acceptance

of the results of recent "positive" studies and little inquiry into mechanisms through which "bilingualism" exerts its effects.

The lack of concern for the developmental interrelationships between language and thought in the bilingual child is one of the major reasons why evaluations and research have provided so little data on the dynamics of the bilingual child's interaction with his/her educational environment. A direct determinant of the quality of this interaction is clearly the level of L1 and L2 competence which the bilingual child develops over the course of his/her school career. It is impossible to avoid questions like the following if one wishes to explore the assumptions underlying bilingual education: What level of L2 competence must the child possess at various grade levels in order to benefit optimally from instruction in that language? To what extent is a bilingual child who has developed fluent surface skills in L1 and L2 also capable of carrying out complex cognitive operations (e.g., verbal analogies, reading comprehension, mathematical problems) through his/her two languages? To what extent are L1 and L2 skills interdependent and what are the implications of possible interdependencies for cognitive and academic progress? In other words, do children who maintain and develop their L1 in school develop higher or lower L2 levels of skills than those whose L1 is replaced by their L2? Also, to what extent do various patterns of L1-L2 relationships facilitate children's general cognitive and academic progress?

The language-thought issue also has important implications for teaching strategies in bilingual classes. For example, to

ask any question regarding the relative merits of concurrent versus separated patterns of L1 and L2 use or whether teachers should encourage or discourage code-switching (Gonzalez, 1977) necessitates considerations of such issues as the developmental relationships between language and thought in the bilingual child.

Two hypotheses have been developed in order to help account for the different outcomes of immersion and submersion programs and also to provide a theoretical framework for research into the developmental interrelations between language and thought in the bilingual child. The "threshold" hypothesis (Cummins, 1976, 1978c; Toukomaa and Skutnabb-Kangas, 1977) is concerned with the cognitive and academic consequences of different patterns of bilingual skills, and the "developmental interdependence" hypothesis (Cummins, 1978c) addresses the functional interdependence between the development of L1 and L2 skills.

THE THRESHOLD HYPOTHESIS

The threshold hypothesis evolved as an attempt to resolve the apparent inconsistencies in the results of early and more recent studies of the relationships between bilingualism and cognition. These studies will be briefly reviewed in order to outline the phenomena which require explanation.

It seems implausible to dismiss the findings of early studies as entirely due to inadequate controls and to argue that specifically linguistic factors do not contribute to the poor academic achievement of many minority-language bilinguals. The findings of several recent studies support the early negative findings.

Tsushima and Hogan (1975), for example, report lower levels of verbal academic skills among grades 4 and 5 Japanese-English bilinguals compared to a unilingual control group matched on nonverbal IQ. Torrance *et al.* (1970) reported that bilingual children in Singapore performed at a significantly lower level than unilingual children on the fluency and flexibility scales of the Torrance Tests of Creative Thinking. However, the direction of the trend was reversed for the originality, and elaboration scales and differences in elaboration in favor of the bilinguals were significant. There is also strong evidence (Skutnabb-Kangas and Toukomaa, 1976) that some groups of minority language and migrant children are characterized by "semilingualism," (i.e., less than native-like skills in both languages) with its detrimental cognitive and academic consequences.

In contrast to these "negative" findings, however, there exists a substantial number of recent studies that suggest that bilingualism can positively influence academic and cognitive functioning. Several studies conducted within the context of French immersion programs have reported that the immersion students performed better than controls on measures of English skills despite considerably less instruction through the medium of English (Swain, 1975, 1978a; Tremaine, 1975). Enhancement of linguistic skills as a function of intensity of bilingual learning experiences is also suggested by the evaluation of a trilingual Hebrew, French, and English program in Montreal (Genesee *et al.*, 1978). It was reported that over time the trilingual students outstripped those in a bilingual Hebrew-English program in Hebrew

skills despite essentially the same Hebrew curriculum in experimental and control schools. The findings of Dubé and Hébert (1975) suggest that similar processes can operate in minority language contexts when L1 development is promoted by the school. They report enhancement of English (L2) skills by the end of elementary school among children in the St. John Valley French-English bilingual education project in Maine.

Several recent studies have also reported a more analytic orientation to linguistic and perceptual structures among bilingual children (Balkan, 1970; Ben-Zeev, 1977a, 1977b; Cummins, 1978a; Cummins and Mulcahy, 1978; Feldman and Shen, 1971; Ianco-Worrall, 1972). A possible neuropsychological basis for these findings is suggested by the results of a study by Starck *et al.* (1977) who demonstrated more reliable ear asymmetry effects on a dichotic listening task among children attending a trilingual Hebrew, French, and English program as compared to a control group of children whose instruction was totally in English. The significance of this finding is that right ear advantage on dichotic listening tasks reflects greater development of the more analytic left hemisphere functions in comparison to right hemisphere functions. A plausible explanation for findings of greater analytic orientation to language among bilingual children is Lambert and Tucker's (1972) suggestion that the bilingual child engages in a form of "contrastive linguistics" by comparing similarities and differences in the vocabulary and syntactic structures of the two languages.

Greater sensitivity to linguistic, perceptual, and interpersonal feedback cues has also been reported in association with bilingualism (Bain, 1975, 1976; Ben-Zeev, 1977b, 1977a; Cummins and Mulcahy, 1978; Genesee *et al.*, 1975). Ben-Zeev (1977c) points out that increased attention to feedback cues has adaptive significance for the bilingual child as a way of accommodating to the extra demands of his/her linguistic environment.

Significant differences have also been reported between bilinguals and unilinguals on measures of both general intellectual development (Bain, 1975, 1976; Bain and Yu, 1978; Cummins and Gulutsan, 1974; Liedke and Nelson, 1968; Peal and Lambert, 1962) and divergent thinking (Carringer, 1974; Cummins and Gulutsan, 1974; Landry, 1974; Scott, 1973; Torrance *et al.*, 1970).

Although, in general, these recent studies are better controlled than the earlier studies that reported negative findings, few are without methodological limitations. A problem in many of these studies (Bain, 1976; Bain and Yu, 1978; Carringer, 1974; Cummins and Gulutsan, 1974; Feldman and Shen, 1971; Landry, 1974; Peal and Lambert, 1962) is the lack of adequate controls for possible background differences between bilingual and unilingual groups. An index of SES based on parental occupation provides inadequate protection against bias. Also, matching only on overall stage of cognitive development (e.g., preoperational, concrete operational, etc.) is insufficient since there can be extremely large individual differences on cognitive variables within stages. Although the remaining studies have matched bilingual and unilingual groups on IQ in addition to SES, the validity of some of the

dependent measures used to assess constructs such as "analytic orientation to language" or "sensitivity to feedback cues" is open to question. Thus, pending replication and extension, these findings should be evaluated cautiously so that, as Fishman (1977) warns, "...bilingualism will not be spuriously oversold now as it was spuriously undersold (or written off) in the past" (p. 38).

Despite the fact that these recent "positive" studies are not methodologically flawless, taken together they suggest that under some conditions, access to two languages in early childhood can accelerate aspects of cognitive growth. A distinguishing characteristic of many of these studies is that they involved bilingual subjects whose bilingualism was "additive" (Lambert, 1975). In other words, since the bilingual's L1 was dominant or at least prestigious, it was in no danger of replacement by L2. Consequently, the bilingual was adding another language to his/her repertory of skills at no cost to L1 competence. In contrast, many of the "negative" studies involved bilingual subjects from minority-language groups whose L1 was gradually being replaced by a more prestigious L2. Lambert (1975) terms the resulting form of bilingualism "subtractive" since the bilingual's competence in two languages at any point in time is likely to reflect some stage in the "subtraction" of L1 and its replacement by L2. Thus, the bilingual child in an additive situation is likely to have relatively high levels of competence in both languages whereas in subtractive situations many bilinguals may be characterized by less than native-like levels in both languages.

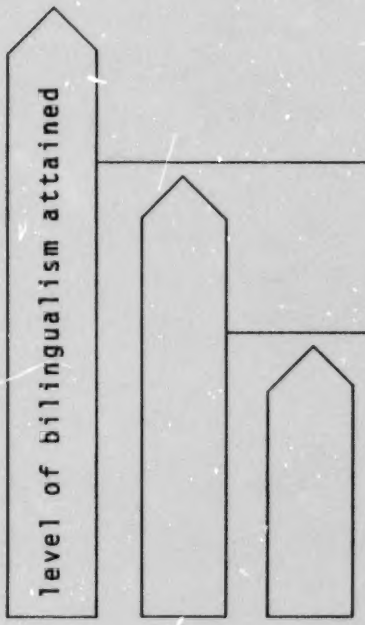
This analysis suggests that the level of competence bilingual children achieve in their two languages acts as an intervening variable in mediating the effects of their bilingual learning experiences on cognition. Specifically, there may be threshold levels of linguistic competence which bilingual children must attain both in order to avoid cognitive deficits and to allow the potentially beneficial aspects of becoming bilingual to influence their cognitive growth (Cummins, 1976, 1978c).

The threshold hypothesis assumes that those aspects of bilingualism that might positively influence cognitive growth are unlikely to come into effect until the child has attained a certain minimum or threshold level of competence in a second language. Similarly, if a bilingual child attains only a very low level of competence in the second (or first) language, interaction with the environment through that language, both in terms of input and output, is likely to be impoverished.

The form of the threshold hypothesis that seems to be most consistent with the available data is that there is not one, but two, thresholds (Cummins, 1976; Toukomaa and Skutnabb-Kangas, 1977). The attainment of a lower threshold level of bilingual competence would be sufficient to avoid any negative cognitive effects; but the attainment of a second, higher level of bilingual competence might be necessary to lead to accelerated cognitive growth. This possibility is expressed in Figure 1.

Figure 1

Cognitive Effects of Different Types of Bilingualism*



Type of bilingualism	Cognitive effect	
A. *additive bilingualism* high levels in both languages	positive cognitive effects	
		higher threshold level of bilingual competence
B. *dominant bilingualism* native-like level in one of the languages	neither positive nor negative cognitive effects	
		lower threshold level of bilingual competence
C. *semilingualism* low level in both languages (may be balanced *or* dominant)	negative cognitive effects	

*Adapted from Toukomaa and Skutnabb-Kangas, 1977.

The Lower Threshold

It can be seen in Figure 1 that negative cognitive and academic effects are hypothesized to result from low levels of competence in both languages or what Scandinavian researchers (Hansegard, 1968; Skutnabb-Kangas and Toukomaa, 1976) have termed "semilingualism" or "double semilingualism" (see Paulston, 1976, for a review of the Scandinavian research). Essentially, the lower threshold level of bilingual competence proposes that bilingual children's competence in a language may be sufficiently weak as to impair the quality of their interaction with their educational environment through that language. The threshold cannot be defined in absolute terms; rather it is likely to vary according to the children's stage of cognitive development and the academic demands of different stages of schooling. Possibly one of the reasons why no cognitive retardation has been observed in the early grades of immersion programs (when instruction is totally through L2) is that during these grades the children's interaction with environment and, consequently, cognitive development, is less dependent on the mediation of language than at later grades. This may give these children a "breather" in which they can gain the L2 skills necessary to benefit optimally from an increasingly symbolic environment (Cummins, 1976). Thus, in the early grades the lower threshold may involve only a relatively low level of listening comprehension and expressive skills, but as the curriculum content becomes more symbolic and requires more abstract formal operational thought processes, the children's "surface" L2 competence must be translated into deeper levels of

"cognitive competence" in the language. The development of adequate literacy skills are obviously important in this respect. The child whose reading comprehension skills is poorly developed will be handicapped in assimilating most types of subject matter content after the early grades. Olson (1977b) has suggested that the acquisition of literacy skills has more general cognitive significance in that it may be the means by which the child becomes proficient in using logical or ideational functions of language.

The concept of "semilingualism" does not in any sense imply that minority children's language is itself deficient. As Skutnabb-Kangas and Toukomaa (1976) point out, the term "cannot be used as a strictly linguistic concept at all" (p. 22). Research that viewed semilingualism as a purely linguistic variable found little support for the concept. However, research that supported the concept of semilingualism "measured cognitive aspects of the language, understanding of the meanings of abstract concepts, synonyms, etc. as well as vocabulary" (Skutnabb-Kangas and Toukomaa, 1976, p. 21). Thus, as Skutnabb-Kangas and Toukomaa (1976) point out, although parents, teachers, and the children themselves considered Finnish migrant children's Swedish to be quite fluent, tests in Swedish that required complex cognitive operations to be carried out, showed that this surface fluency was to a certain extent a "linguistic facade."

The Higher Threshold

Because of the widespread academic failure of minority-language children and the fact that many of them clearly have less

than native-like competence in both languages, the existence of a lower threshold level of bilingual competence is probably less contentious than the existence of a higher threshold. However, direct evidence for the concept of a higher threshold level of bilingual competence is provided in several of the recent studies that suggest that an additive form of bilingualism can positively influence cognitive functioning. If there is a higher threshold level of bilingual competence, then we would expect that as children in immersion programs develop high levels of L2 skills, they would also begin to reap the cognitive benefits of their bilingualism. The findings of Barik and Swain (1976) support this prediction. Using longitudinal data from the Ottawa and Toronto immersion programs, Barik and Swain reported that high French achievers at the grade 3 level performed significantly better than low French achievers on two of the three Otis-Lennon IQ subtests when scores were adjusted for initial IQ and age differences between the two groups. There is no evidence that the low French achievers (i.e., those who remained very dominant in English category B in Figure 1) suffered any cognitive disadvantages since their IQ scores remained unchanged over the three year period. However, the IQ scores of the high French achievers increased over the three year period, suggesting that the attainment of high levels of L2 skills is associated with greater cognitive growth.

Differences between the achievement of children in partial and total immersion programs (Swain, 1978a) can also be interpreted in terms of the threshold hypothesis. Swain reports that children in French-English partial immersion programs who have had

approximately 50 percent of their instruction in English (L1) throughout elementary school take as long as total immersion students to catch up with regular program students in English achievement. In addition, their French skills are considerably lower than those of total immersion students although there is an equivalence of French skills in terms of time spent through French. In other words, the French achievement of grade 2 total immersion students is similar to that of grade 4 or 5 partial immersion students who have spent about the same amount of time learning through French. Swain (1978a) reports that there have been some indications of poorer performance in subject matter taught through French among partial immersion students, but this finding may not be generalizable to immersion programs in general. In addition, by grade 5, total immersion students were performing at a significantly higher level in English as compared to regular program control groups, whereas no such trend was noted for students in partial immersion programs. These findings (together with those of Tremaine, 1975) suggest that because of the more intensive exposure to French in kindergarten and grades 1 and 2, the total immersion students quickly attain a level of functional competence in French. This allows them to benefit optimally from interaction with a French school environment and, over the course of elementary school, enhances the development of their English L1 skills. The partial immersion students, on the other hand, take considerably longer to attain high levels of French skills. Consequently, they are less likely to experience enhancement of cognitive or academic skills and may have greater difficulty than

total immersion pupils in mastering subject matter taught through French. In terms of Figure 1, many of the total immersion students could be classified in category A whereas the majority of partial immersion students would fit the pattern of category B. However, despite the less intensive initial exposure to French, the possibility of cognitive benefits for some partial immersion students who do acquire high levels of French skills should not be ruled out.

It is clear that in minority language situations a prerequisite for attaining a higher threshold level of bilingual competence is maintenance of L1 skills. The findings of several research studies suggest that maintenance of L1 skills can lead to cognitive benefits for minority-language children. As mentioned earlier Dubé and Hébert (1975) have reported that Franco-American children instructed bilingually performed better in English skills than control children by the end of elementary school. Cummins and Mulcahy (1978) compared two groups of children attending a Ukrainian-English bilingual program with a unilingual control group matched for IQ, SES, sex, age, and school at both grades 1 and 3 levels. One group of bilingual children had extensive Ukrainian at home and were judged by their teachers to be relatively fluent in Ukrainian. The second group had little or no Ukrainian at home and were judged by teachers to have little fluency in Ukrainian. Consistent with the threshold hypothesis, it was found that the fluent bilingual group was significantly better able than either the non-fluent bilinguals or unilinguals to analyze ambiguities in sentence structure. In

a study of lower SES Spanish-English balanced bilinguals, Ben-Zeev (1977a) has also reported that in comparison to a unilingual control group, the response strategies of the bilinguals were characterized by attention to structure and readiness to reorganize cognitive schemata.

In summary, initial research findings support the hypothesis that the level of linguistic competence attained by bilingual children may act as an intervening variable in mediating the effects of bilingualism on their cognitive and academic development. This suggests that the threshold hypothesis can provide a framework with which to predict the academic and cognitive effects of different forms of bilingualism. However, the threshold hypothesis tells us little about how L1 and L2 skills are related to one another or about what types of school programs are likely to promote additive and subtractive forms of bilingualism under different bilingual learning conditions. The "developmental interdependence" hypothesis addresses itself to these issues.

THE DEVELOPMENTAL INTERDEPENDENCE HYPOTHESIS

The developmental interdependence hypothesis proposes that the level of L2 competence that a bilingual child attains is partially a function of the type of competence the child has developed in L1 at the time when intensive exposure to L2 begins. When the usage of certain functions of language and the development of L1 vocabulary and concepts are strongly promoted by the child's linguistic environment outside of school, as in the case of most middle-class children in immersion programs, then intensive expo-

sure to L2 is likely to result in high levels of L2 competence at no cost to L1 competence. The initially high level of L1 development makes possible the development of similar levels of competence in L2. However, for children whose L1 skills are less well developed in certain respects, intensive exposure to L2 in the initial grades is likely to impede the continued development of L1. This will, in turn, exert a limiting effect on the development of L2. In short, the hypothesis proposes that there is an interaction between the language of instruction and the type of competence the child has developed in L1 prior to school.

This basic idea has previously been expressed by Toukomaa and Skutnabb-Kangas (1977). In discussing the threshold hypothesis in minority language situations they argue that:

> The basis for the possible attainment of the threshold level of L2 competence seems to be the level attained in the mother tongue. If in an early stage of its development a minority child finds itself in a foreign-language learning environment without contemporaneously receiving the requisite support in its mother tongue, the development of its skill in the mother tongue will slow down or even cease, leaving the child without a basis for learning the second language well enough to attain the threshold level in it. (p. 28)

I shall first review the research evidence that is related to the developmental interdependence hypothesis and then consider in more detail the mechanisms through which a child's L1 experience may influence the development of L2 skills.

Research Evidence

At a very general level it has frequently been observed that L1 and L2 reading scores are very highly correlated (Cziko, 1976;

Greaney, 1977; Swain *et al.*, 1976; Skutnabb-Kangas and Toukomaa, 1976; Tucker, 1975). Also, in middle-class majority language situations, L1 seems to be impervious to "neglect" by the school. McDougall and Bruck (1976), for example, report that the grade level at which L1 reading is introduced in immersion programs appears to make very little difference to L1 reading achievement. Macnamara *et al.* (1976) draw a similar conclusion from an investigation of the achievement of children attending primary schools of the "other" language in Montreal. No differences in English achievement were observed between grade 6 English-speaking children attending French-medium and English-medium schools despite the fact that the children in French schools received no instruction in English until grade 3 or grade 5. Also, there was no evidence that beginning English reading instruction in grade 3 rather than grade 5 made any difference to the grade 6 scores. Macnamara *et al.* (1976) conclude that "...school seems to contribute little to reading one's native language apart from some basic mechanical skills" (p. 123). Another relevant finding is that children in immersion programs achieve levels of L2 reading skills equivalent to native speakers by the end of elementary school (Swain, 1978a).

These data suggest that: (1) the prerequisites for acquiring literacy skills are instilled in most middle-class majority language children by their linguistic experience in the home; (2) the ability to extract meaning from printed text can be transferred easily from one language to another.

The UNESCO report prepared by Skutnabb-Kangas and Toukomaa (1976) provides evidence from a minority language learning situa-

tion that is consistent with the developmental interdependence hypothesis. The purpose of the UNESCO investigation:

> ...was to determine the linguistic level and development in both their mother tongue and Swedish of Finnish migrant children attending Swedish comprehensive school. Above all, attention was paid to the interdependence between skills in the mother tongue and Swedish, i.e. the hypothesis was tested that those who have best preserved their mother tongue are also best in Swedish. (p. 48)

This hypothesis was strongly supported by the findings. Although the Finnish migrant children had average levels of nonverbal intellectual ability, their skills in both Finnish and Swedish were considerably below Finnish and Swedish norms. The extent to which the mother tongue had been developed prior to contact with Swedish was strongly related to how well Swedish was learned. Children who migrated at age 10 maintained a level of Finnish close to Finnish students in Finland and achieved Swedish language skills comparable to those of Swedes. Skutnabb-Kangas and Toukomaa (1976) suggest that:

> Their skills in the mother tongue have already developed to the abstract level. For this reason they reach a better level in the mastery of Swedish-language concepts in quite a short time than those who moved before or at the start of school, and before long surpass even the migrant children who were born in Sweden. (p. 76)

The situation is very different for children who were 7-8 years of age when they moved to Sweden.

> The verbal development of these children, who moved just as school was beginning, underwent serious disturbance after the move. This also has a detrimental effect on learning Swedish. In this group, and in those who moved before starting school, the risk of becoming semilingual is greatest. (p. 75)

These findings are consistent with the results of several studies summarized by Engle (1975, pp. 311-312) which reported that children between the ages of 6-8 experience considerable difficulty in language learning. They are also consistent with informal observations (Cardenas, p. 57 in Epstein, 1977; Gonzalez, 1977) that recently-arrived immigrant children from Mexico whose Spanish is firmly established are more successful in acquiring English skills than native-born Mexican-Americans.

However, the UNESCO findings do not agree with data on Canadian immigrant children (Ramsey and Wright, 1974) which suggest that children who arrived at older ages experienced greater educational difficulty than children who arrived prior to school entry or who were born in Canada. Some of the difference between the Swedish and Canadian results can be attributed to motivational factors which will be discussed below. However, another reason for the difference may be that many of the Canadian immigrant children come from rural areas in Southern Europe where educational programs are likely to be less developed than in Canada. Thus, the schooling experiences of the adolescent immigrants may not have been effective in developing the type of linguistic competence necessary to allow them to quickly learn L2 and adapt to a highly abstract school curriculum. In contrast, Finland is a highly industrialized country whose educational system is equivalent to that of Sweden.

Skutnabb-Kangas and Toukomaa (1976) also report that mother tongue development is especially important in school subjects that require abstract modes of thought:

> In the upper level Finnish seems to be even more important for achievement in mathematics than Swedish--in spite of the fact that mathematics too is taught in Swedish. This result supports the concept that the abstraction level of the mother tongue is important for mastering the conceptual operations connected with mathematics....Subjects such as biology, chemistry and physics also require conceptual thinking, and in these subjects migrant children with a good mastery of their mother tongue succeeded significantly better than those who knew their mother tongue poorly. (p. 69)
>
> ...the migrant children whose mother tongue stopped developing before the abstract thinking phase was achieved thus easily remain on a lower level of educational capacity than they would originally have been able to achieve. (p. 70)

The UNESCO findings were followed up in a small study conducted with grade 1-2 students on the Hobbema Cree Indian Reserve in Alberta (Leslie, 1977). Many of the families on the reserve speak both Cree and English at home or a mixture of both and the school is unilingual English. Leslie found high correlations between children's oral Cree competence and English reading skills (r, Gates-McGinitie vocabulary and Cree = .76, $p < .001$; r, Gates McGinitie comprehension and Cree = .66, $p < .01$). This result again suggests the functional significance of the mother tongue in the child's educational development.

An important index of the validity of the developmental interdependence hypothesis is the academic achievement of minority-language pupils whose L1 is promoted at school and at home. As mentioned earlier, the issues involved in bilingual education and its evaluation are complex (Gonzalez, 1977) and there is a scarcity of meaningful data. Here I shall only briefly point to some results that suggest the value of mother tongue maintenance.

A comprehensive review of recent studies relevant to this issue can be found in Paulston (1977).

In a study of the academic achievement of minority francophone children in Manitoba, Hébert (1976) found that the percentage of instruction received in French (L1) had no influence on English achievement but was strongly related to French achievement. In other words, promoting children's L1 resulted in higher levels of L1 achievement at no cost to achievement in L2. Ramírez and Politzer (1976) similarly reported that use of Spanish at home resulted in higher levels of Spanish skills at no cost to English achievement while the use of English at home resulted in a deterioration of Spanish skills but no improvement in English. In both these studies a loss in L1 did not result in any gains in L2 despite the increased interaction through L2. In terms of the developmental interdependence hypothesis, these findings would be interpreted as indicating that the positive effects on L2 of maintaining L1 compensated for less time spent in L2.

Most of the findings supporting vernacular education are also consistent with the hypothesis. Modiano's study (1968) is usually regarded (Engle, 1975; Paulston, 1976) as one of the best controlled studies that support the "vernacular advantage" theory. She reported that Mexican Indian children who were taught to read in the vernacular and later in Spanish scored significantly higher in Spanish reading after three years than children taught to read only in Spanish.

Findings such as these are sometimes regarded as contradictory to the findings of immersion programs where initial instruc-

tion is in L2 (Engle, 1975). However, when viewed within the framework of the developmental interdependence and threshold hypotheses, it can be seen that identical principles underly the success of both types of programs. The key to understanding the educational outcomes of a variety of bilingual education programs operating under very different conditions lies in recognizing the functional significance of the child's mother tongue in the developmental process. In immersion programs for majority-language children, the children's L1 is developed in such a way that it is unaffected by intensive exposure to L2. Consequently, as children develop high levels of L2 skills, their fluent access to two languages can give rise to enhancement both of L1 skills and other aspects of cognitive functioning.

The findings in many minority language situations appear to be just the opposite of those in majority language situations in that initial instruction in L1 has been found to lead to better results than immersion or submersion in L2. The developmental interdependence hypothesis would suggest that the relatively greater success of vernacular education in minority language situations is due, partly at least, to the fact that certain aspects of the minority child's linguistic knowledge may not be fully developed on entry to school. Thus, some children may have only limited access to the cognitive-linguistic operations necessary to assimilate L2 and develop literacy skills in that language.

The "threshold" and "developmental interdependence" hypotheses attempt to integrate data which suggest that linguistic factors

are important in understanding the dynamics of the bilingual child's interaction with the educational environment. Before considering how these hypotheses fit into an overall model of bilingual education, it is necessary to consider in more detail the mechanisms through which children's knowledge of L1 on entry to school might interact with the language of instruction.

L1 DEVELOPMENT AND HOME-SCHOOL LANGUAGE SWITCHING

It has been suggested that differences in the way in which children's L1 has been developed by their linguistic experience prior to school contribute to the differential outcomes of a home-school language switch in minority and majority language situations. However, there has been little consideration of which aspects of L1 development interact with medium of instruction. This can be meaningfully discussed only in relation to the types of information that the child is required to process in school. The primary academic task for the child is learning how to extract information efficiently from printed text, and subsequent educational progress largely depends upon how well this task is accomplished. Thus, for present purposes, the differential outcomes of a home-school language switch can be discussed in relation to the extent to which the L1 experience of minority and majority language children prior to school has provided them with the prerequisites for acquiring fluent reading skills. This focus is consistent with the research studies reviewed in the previous section, most of which involved interdependence between reading comprehension skills in L1 and L2.

As Smith (1971) points out, fluent reading skills require that the reader's knowledge of language is used to make inferences or predictions about information in the text. A child who has to read word-by-word will lose much of the information before it can be comprehended. It is possible to distinguish three general aspects of children's knowledge of language that have been hypothesized as important for the acquisition of fluent reading skills. First is what Becker (1977) has termed the "vocabulary-concept knowledge" of the child; second is the extent to which the child has acquired certain metalinguistic insights regarding the nature of printed text; and third is the extent to which the child has developed facility in processing language that is decontextualized and possibly in using certain other functions of language. Although these three aspects can be distinguished conceptually, all are determined by the child's linguistic experiences prior to school and are likely to be strongly related to one another empirically.

VOCABULARY-CONCEPT KNOWLEDGE

Becker (1977) uses the term vocabulary-concept knowledge to refer to a child's understanding of the concepts or meanings embodied in words. He argues that the failure of the DISTAR language program to significantly improve reading comprehension skills in contrast to decoding spelling and math skills is due to the fact that reading comprehension is largely dependent on the child's vocabulary-concept knowledge. According to Becker (1977) the learning of vocabulary and concepts usually involves a "linear-additive set" in which the learning of one element gives

little advantage to learning a new lement. This is in contrast to other achievement areas wi re strategies for problem-solving can be effectively taught.

Several investigators (Carrol 1971; Morris, 1972) have also argued that children's knowle e of vocabulary and the grammatical functions of words pla a major role in explaining the progressively poorer performan of minority-language children on measures of reading comprehensi . This contention is supported by the universally high cor lations found between vocabulary and reading comprehension. orris (1972) has suggested that the purpose of teaching readi at the secondary level is to help students explore, interpre and extend the concepts represented by the written symbols. owever, although minority-language children can very adequate y decode the symbol and produce the word, often the word:

> ...fails to trigger *anyt ng* because the concepts it represents to u and to the author simply do not exist for e child, or they exist in a limited, vagu form. (p. 162)

It is clear that efficient predict n of information and fluent reading comprehension are impossib if the reader does not understand the concepts to which the wo s refer. Morris goes on to suggest that some minority-languag children may never have had the opportunity to develop the con ptual basis for abstraction in English. The developmental int dependence hypothesis would suggest that this may be due to th fact that their schooling experience has never allowed them continue to develop the conceptual basis for abstraction in L In other words, the deficient conceptual knowledge that Mo is (1972) describes at the

secondary level results from the interaction between certain forms of educational treatment and a child's input conceptual-linguistic knowledge. If a child on entry to school does not have access to the semantic meanings assumed by beginning reading texts and culturally-different schools, the early search for meaning in printed texts is likely to be futile. For many minority-language children it appears likely that the semantic prerequisites for literacy skills can be developed more easily through L1 than through L2.

Several investigators have drawn attention to the fact that some bilingual children who have been exposed to both languages in an unsystematic way prior to school, come to school with less than native-like command of the vocabulary and syntactic structures of both L1 and L2 (Gonzalez, 1977; Kaminsky, 1976). Gonzalez (1977) suggests that under these conditions children may switch codes because they do not know the label for a particular concept in the language they are speaking but have it readily available in the other language. Because the languages are not separated, each acts as a crutch for the other with the result that the children may fail to develop full proficiency in either language. Kaminsky (1976) has argued that these bilingual children may fail to develop fluent reading skills since their knowledge of the syntactic rules and vocabulary of each language may be insufficient to make accurate predictions regarding the information in the text.

METALINGUISTIC INSIGHTS

Smith (1977) suggests that children must acquire two insights in order to learn to read. The first is the insight that print is meaningful, and the second is that written language is different from speech. Unless children realize that differences on a printed page have a function, they will not be motivated to learn to read. Furthermore, if children do not realize that written language is different from spoken language, their predictions regarding the meanings in the text are likely to be inaccurate. Smith (1977) sums up his discussion of these insights by stating that "[c]hildren who can make sense of instruction should learn to read; children confronted by nonsense are bound to fail" (p. 395).

DECONTEXTUALIZED LANGUAGE

Related to the differences between spoken and written language is the child's facility in using and assimilating language that is decontextualized, i.e., taken out of the context of the immediate interpersonal situation. As Olson (1977b) points out, a central characteristic of written text is that it is an autonomous representation of meaning and depends on no cues other than linguistic ones. Several investigators (e.g., Elsasser and John-Steiner, 1977; Olson, 1976, 1977b; Vygotsky, 1962) have stressed the importance of literacy in promoting the decontextualization and elaboration of thought processes. However, the extent to which children have developed facility in processing linguistic information independent of interpersonal cues prior to school will also clearly influence how easily they acquire

literacy skills.

Facility in processing decontextualized language can be regarded as one aspect of an individual's functional linguistic competence. As such it involves what Halliday (1973) has termed the "representational" function of language, which is concerned with the processing and communication of information. The distinction between interpersonal and ideational or logical functions of language (Olson, 1977a) is also relevant. The ideational function of language specifies the semantic and logical relations between subject and predicate of a sentence while the interpersonal function relates the logical component to the requirements of the listener. Olson (1977a) suggests that "[l]iterate language, especially that of prose text, the language of schooling, is responsible...for differentiating the logical from the interpersonal functions of language..." (p. 113).

These aspects of functional linguistic competence appear likely to be most directly related to the development of fluent reading skills. However, individual differences in using other functions of language are clearly important for other aspects of educational adjustment. Halliday (1973), for example, has emphasized the importance of facility in using the personal and heuristic functions of language. The personal function refers to the child's expression of identity and individuality through language while the heuristic function involves the use of language to learn and to explore reality.

The three aspects of linguistic development that have been described are likely to be differentially reinforced by the L1

experience of middle and low SES children. As Olson (1976) suggests:

> Highly literate parents may be expected to communicate the explicit logical structure of printed texts in at least two ways, through their own abstract language and, probably more importantly, through reading printed stories. (p. 201)

Smith (1977) has also emphasized that the only way children can acquire the insight that written language is different from spoken language is by hearing written language read aloud. Clearly, this is also likely to promote the development of a child's conceptual knowledge. Low SES minority-language children are likely to be worse off in this respect than low SES children in a unilingual situation because of the unavailability of reading materials in L1 and lack of exposure to L1 on TV and outside the home.

Although these aspects of children's "input" linguistic knowledge are likely to be highly related to the acquisition of fluent reading skills whether L1 or L2 is used as the initial medium of instruction, this does not mean that the language of instruction is "linguistically irrelevant" as Bowen (1977) argues. The hypothesis advanced in this paper is that there is an interaction between these aspects of L1 development and initial medium of instruction. Medium of instruction may be irrelevant for children whose knowledge of L1 is well advanced. However, for minority-language children who have not been exposed to a literate L1 environment prior to school, the initial medium of instruction may be vitally important. Such a child's L1 vocabulary-concept knowledge may be limited, there may be difficulty assimilating decontextualized language, and there is little insight into the

fact that print is meaningful and that written language is different from speech. Thus, in Smith's (1977) terms, many of these children may be "confronted by nonsense" in the task of learning to read; and the development of fluent reading skills is likely to be difficult even when instruction is through L1. However, when reading is introduced through L2, the task is likely to be considerably more difficult since there is no way in which children relate the printed symbols to their knowledge of spoken language. Even where minority-language children do have some knowledge of L2 as a result of unsystematic exposure to it prior to school, their knowledge of the language is likely to bear little resemblance to its representation in printed text.

It might be objected that the middle-class immersion child has very little knowledge of the vocabulary and syntax of L2 when L2 reading instruction is begun. However, in contrast to the low SES minority-language child, the immersion child is likely to have developed a certain degree of facility in processing decontextualized information and also to have acquired or be quickly capable of acquiring, the insights that print is meaningful and that written language is different from speech. In addition, through their L1 experience they are likely to have developed an understanding of most of the concepts they will encounter in their early reading of L2. Thus, although initially immersion children may have only a relatively limited knowledge of L2, this is likely to be developed in the process of learning to read L2 since the task is meaningful and children are highly motivated to learn L2. The fact that the children are already familiar with

the concepts encountered in learning L2 means that their task is essentially learning a new label for an already existing concept. One might reverse Brown (1958) dictum and suggest that the presence of the concept is an invitation to acquire the word. This task is clearly very different from that of low SES minority-language children who may not have a conceptual basis in either L1 or L2 for the vocabulary encountered in L2. Thus, in order to develop fluent reading skills, minority-language children may be required to develop or expand their conceptual knowledge by means of a language that is poorly understood. It is not surprising that, under these circumstances, many low SES minority-language children become "semi-literate" i.e., develop less than native-like levels of literacy in both languages. The threshold hypothesis would predict that this would be a progressively deteriorating state and that it would have broader cognitive ramifications in that the children's ability to interact with their educational environment and expand their conceptual knowledge would be reduced.

The fact that, in comparison to middle-class children, low SES minority-language children may be more dependent on the school to provide the prerequisites for the acquisition of literacy skills does not imply that these children's basic cognitive abilities are in any sense deficient nor that their command of the linguistic system of their L1 is necessarily inadequate. It does imply, however, that the school program must be geared to the needs of individual children if they are to attain an additive form of bilingualism involving fluent literacy skills in L1 and L2. If

the process of instruction is to be meaningful, it must reflect the child's cultural experiences and build upon the child's competencies. A low SES minority-language child may have less knowledge of some aspects of language and may have developed different functional linguistic skills on entry to school than a middle-class child. However, the child's input linguistic knowledge is translated into deficient levels of L1 and L2 competence only when it is reinforced by inappropriate forms of educational treatment. Thus, a child's cognitive, linguistic, and academic growth can be conceptualized only in terms of the interaction between child input and educational treatment. This is the basis for the model of bilingual education outlined in the next section.

AN INTERACTION MODEL OF BILINGUAL EDUCATION

As Gonzalez (1977) points out, one of the reasons why bilingual programs for Mexican-American children may have had mixed results is because educators have implicitly assumed that these children constitute a homogeneous group for whom instruction through the medium of a prestige variety of Spanish is uniformly appropriate. He suggests that in order to be optimally effective, school programs and teachers must accommodate to the diversity that exists within their student population. To the extent that bilingual programs do not currently do this, it follows that they are differentially effective in promoting academic and cognitive growth for different sub-groups of students.

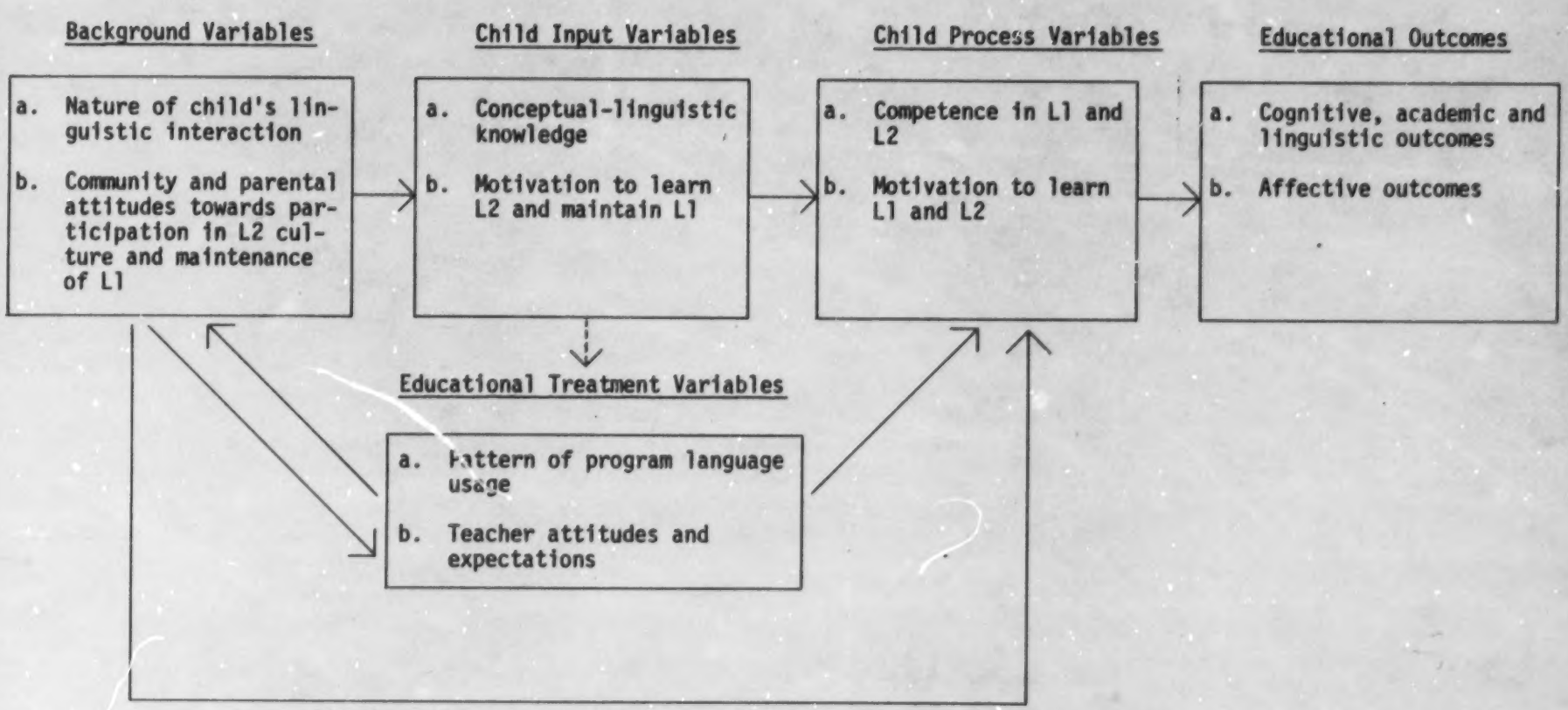
Given this fact, it seems reasonable to suggest that evaluations should aim to discover what are the relevant dimensions of

child input and how they interact with different patterns of educational treatment. Instead, much of the controversy surrounding bilingual education has centered around the relative merits of transitional versus maintenance programs versus ESL-only programs, with little attempt to relate the program impact to the diversity of student input. There are very few clearcut data on the academic and cognitive effects of each of these types of programs and virtually none on the mechanisms through which these programs may have exerted their effects. The reason, I would suggest, is that evaluations have ignored the *interaction* between educational treatment variables and student input characteristics. The model outlined in Figure 2 is designed to allow Child Input variables to be systematically related both to Background and Educational Treatment variables.

The influence of both Background and Educational Treatment variables has been considered by several other investigators (e.g., Cohen and Swain, 1976; Fishman, 1977; Paulston, 1976, 1978; Swain, 1978b; Tucker, 1977) and need not be considered in detail here. The two Child Input dimensions of conceptual-linguistic knowledge and motivation to learn L2 and maintain L1 are specified on the basis of data which suggest that individual differences in these dimensions are important determinants of academic outcomes in bilingual programs. The Background variables specified are those that appear most likely to determine the Child Input variables while the two Educational Treatment dimensions are those most likely to interact with Child Input variables. The pattern of program language usage refers not only to distinctions such as

Figure 2

INTERACTION MODEL OF BILINGUAL EDUCATION


Background Variables
a. Nature of child's linguistic interaction
b. Community and parental attitudes towards participation in L2 culture and maintenance of L1
Child Input Variables
a. Conceptual-linguistic knowledge
b. Motivation to learn L2 and maintain L1
Child Process Variables
a. Competence in L1 and L2
b. Motivation to learn L1 and L2
Educational Outcomes
a. Cognitive, academic and linguistic outcomes
b. Affective outcomes
Educational Treatment Variables
a. Pattern of program language usage
b. Teacher attitudes and expectations

those between maintenance, transitional, and ESL-only programs but also to patterns of language usage within the classroom (e.g., concurrent versus separated patterns of L1 and L2 usage). Obviously, all these dimensions are outlined only at a very general level and the purpose of listing them is to indicate the types of variables that evaluations should attempt to assess. At different levels of analysis different sets of variables might assume more relevance than those specified here.

A two-way interaction is posited between Background and Educational Treatment factors. School programs for minority-language children are a result of particular constellations of social factors (Paulston, 1976, 1978), but the establishment of a particular program is capable of influencing a community's attitudes and behavior in relation to linguistic issues such as L1 maintenance. The Child Input variables represent those characteristics of students on entry to a particular school program that are likely to interact with patterns of L1 and L2 usage in the school.* "Conceptual-linguistic knowledge" refers to those aspects of L1 development that were specified earlier (namely, vocabulary-concept knowledge, metalinguistic insights, and knowing how to process decontextualized language). The developmental inter-

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*Although cognitive abilities and styles (see Ramírez *et al.*, 1977) clearly interact with various educational treatment variables, they are not specified in the present model because they do not appear to carry specific implications with regard to the initial pattern of L1 and L2 usage in particular school programs. For example, individual differences in degree of field-sensitivity or field-independence do not appear likely to interact with patterns of L1 and L2 usage in the school. Clearly, however, a more inclusive model that was not confined to bilingual program evaluation would include input variables related to children's strategies for learning.

dependence hypothesis attempted to specify how the linguistic characteristics of students might interact with the language of instruction. (Motivational inputs, whose role is more obvious, will be considered in a later section.) The broken arrow between Child Input and Educational Treatment is meant to indicate that the characteristics and needs of students ought to be a factor in determining the appropriate form of educational intervention.

Child Process variables are determined by the initial interaction between Child Input and Educational Treatment and are in constant interaction with Educational Treatment variables. The threshold hypothesis focused on the extent to which the child's process competence in L1 and L2 effectively promotes interaction with an increasingly symbolic educational environment. Although Child Process variables determine the manner in which the child adapts to the educational environment, they are also capable of being influenced by changes in that environment (e.g., change of teacher, pattern of program, and language usage). They can also be influenced independently by Background factors; for example, an increase in exposure to L2 and to L2 speakers due to a change of neighborhood could influence both process competence in L2 and motivation to learn L2.

The educational outcomes that are determined by the child's interaction with the educational environment include not only academic and cognitive outcomes but also the broad domain of affective outcomes (e.g., identity and attitudes towards L1 and L2 cultures.) Level of absenteeism in particular programs may be a sensitive indicator of some of these affective outcomes.

The relevance of this model for current practice in evaluating bilingual education programs can be seen by considering the evaluation of Title VII programs conducted by the American Institutes of Research (AIR) (1977). On the basis of pre- and posttests separated by a five month interval, the AIR reported that bilingual education programs appeared to have little effect on student achievement. However, as pointed out by the Center for Applied Linguistics (1978), the AIR findings are uninterpretable since students whose language abilities are extremely varied and who have received a variety of educational treatments are aggregated for purposes of data analysis. Thus, the evaluation reveals no appreciation of the complex interactions which are possible between diverse Child Input and Educational Treatment variables.

INTERACTION BETWEEN LINGUISTIC AND MOTIVATIONAL INPUTS AND EDUCATIONAL TREATMENTS

When taken together, the developmental interdependence and threshold hypotheses imply that academic and cognitive outcomes are a function of the type of linguistic knowledge that the child brings to the school and the competence in L1 and L2 developed in interaction with educational treatment variables over the course of the school career. These hypotheses imply that for the child whose input conceptual-linguistic knowledge is not conducive to the development of literacy skills, initial instruction should be through the medium of L1. In addition, instruction through L1 should continue after the initial grades in order to develop a cognitively and academically beneficial form of additive bilingualism. However, motivational aspects of Child Input are also

likely to interact both with linguistic input variables and Educational Treatments and must be considered before implications can be drawn for program planning.

The motivation of children to learn L2 is closely tied to their attitudes towards L2 speakers (e.g., Lambert, 1967; Wong, 1976). Where there is a strong desire to identify with members of the L2 group, the children will be highly motivated to learn L2. Conversely, motivation to learn L2 is likely to be low when the learning of L2 is regarded as a threat to the child's identity. As Lambert (1967) points out, there are four possible ways in which minority-language children can work out their identity in relation to their participation in two cultures:

1. harmonious identification with both L1 and L2 cultures;
2. identification with L2 culture, rejection of L1 culture;
3. identification with L1 culture, rejection of L2 culture;
4. failure to identify with either culture.

These patterns of identification are intimately tied up with the learning of L1 and L2. For example, a child who identified closely with both cultures is more likely to achieve high levels of competence in both languages than a child who identified with neither. Similarly, a child who identifies only with the L2 group is likely to actively promote the replacement of L1 by L2 while a child who rejects the L2 culture will be resistant to the learning of L2.

Wong Fillmore (1976) has illustrated the potency of motivational variables in a one-year longitudinal study of five Spanish-speaking children learning English. There were enormous differences between the five children in the progress they made during the year,

and these differences were strongly related to differences in the extent to which the children sought out the company of English speakers and desired to identify with them. After three months of exposure to English, the most social and outgoing child, Nora, had learned more English than two of the others would learn by the end of the year. Wong Fillmore (1978) suggests that for the child who does not spontaneously seek out L2 input and actively analyze that input, an ESL component in bilingual education may be beneficial.

Harmonious identification with both cultures is a stated goal in most recent educational programs for minority-language children. The central question is: which patterns of L1 and L2 usage in the school will be most effective in promoting this type of identification for which children? Again, it is essential to take into account the interactions between motivational Child Inputs and Educational Treatment variables. For example, for a child such as Nora in Wong Fillmore's study (1976), a L2 total immersion program in kindergarten and grade 1 with L1 introduced as a medium of instruction for part of the school day in subsequent grades (see Epstein, 1977) may be effective in producing an additive form of bilingualism and harmonious identification with both cultures. However, for a child whose attitudes towards L2 speakers are more ambivalent, gradual introduction of L2 as a medium of instruction would seem more appropriate.

At this stage, it is possible only to speculate on the ways in which motivational and linguistic Child Input factors interact and on their relative importance in different situations. For

example, in an earlier section it was suggested that the relatively superior academic performance of Finnish children who migrated to Sweden at the age of 10 in comparison to those who migrated earlier or were born in Sweden (Skutnabb-Kangas and Toukomaa, 1976) might be due to the fact that their L1 was well-developed when intensive exposure to Swedish began. However, the findings are equally susceptible to a motivational explanation. It could be argued that children who were born in Sweden had internalized their parents' negative perceptions of Swedish speakers and that these negative perceptions had been reinforced by a Swedish-only school system, many of whose teachers may have had negative expectations of Finnish children. The "semilingualism" of these children is likely to reflect, partially at least, an inability to feel comfortable with either their Finnish or Swedish identities.

As suggested earlier, motivational factors may help explain the fact that data on Canadian immigrant children in the Toronto School System (Ramsey and Wright, 1974; Rogers and Wright, 1969) do not appear to be consistent with either the Finnish findings or what has been informally observed in relation to Mexican-American children (Cardenas, in Epstein, 1977). In the Canadian situation, minority-language children may not have been subject to negative attribution to the same extent as Finnish or Mexican-American children and consequently may have had greater motivation to learn L2.

High levels of motivation are also likely to contribute to the reasonably good performance of Italian background children in French/English immersion programs (Edwards and Casserly, 1973;

Genesee, 1976). These data are somewhat difficult to interpret due to the fact that specific characteristics of the Italian background children are not known; however, as Genesee (1976) points out "there is nothing in these data to suggest that French immersion would not be suitable for third language children" (p. 510). It is possible that in this type of situation the use of French rather than English as the primary medium of instruction might reduce the tendency to replace the child's home language with English.

The implications of the interactions between Child Inputs and Educational Treatments can be stated quite simply. If the same treatment is differentially effective for children with different input characteristics, then program planners must adopt what Gonzalez (1977) has termed a differentiated approach to bilingual education, which would attempt to match different student inputs with the most appropriate treatments. The only way to discover how educational treatments interact with student inputs is by means of "planned variation" research (Epstein, 1977), which would compare the value of different approaches for different children.

In designing this type of research, it is necessary to develop hypotheses regarding the ways in which Child Inputs might interact with Educational Treatments. The possible interactions between two patterns of Child Input variables and four patterns of Educational Treatment variables are outlined in Table 1.

Only the extreme cases of "high" and "low" levels of both motivation to learn L2 and conceptual-linguistic knowledge are considered. At this stage, there is little point in speculating

Table 1

HYPOTHESIZED INTERACTIONS BETWEEN CHILD INPUT AND EDUCATIONAL TREATMENT VARIABLES

Educational Treatments	Child Inputs: High Language/ High Motivation	Child Inputs: Low Language/ Low Motivation
1. Submersion	-	-
2. L2 Immersion/L1 Maintenance	++	-
3. Transitional Bilingual	+	+
4. Maintenance Bilingual	++	++

-: academic and cognitive performance below comparable unilingual children

+: academic and cognitive performance similar to comparable unilingual children

++: academic and cognitive performance superior to comparable unilingual children

on the effects of having low levels of one factor but high levels of the other. Submersion programs refer to the regular L2 programs that make no concessions either to the culture or language of the minority-language child. The L2 immersion/L1 maintenance program refers to the type of program outlined by Epstein (1977) where L2 is used as an instructional medium in kindergarten and grade 1 but L1 is introduced as an instructional medium for part of the school day at grade 2. Transitional bilingual programs refer to the use of L1 as an instructional medium in the early grades but phasing out to exclusive use of L2 as soon as the child has developed sufficient L2 skills to follow instruction in that language. Finally, maintenance programs would use both languages as media of instruction throughout the child's school career with the aim of developing and maintaining proficiency in both.

The present analysis would suggest that minority-language children who are highly motivated to learn L2 and whose L1 experience has promoted the prerequisites for the acquisition of literacy skills may very well develop a cognitively enriching form of additive bilingualism under treatments 2 and 4. Their L2 skills will develop adequately in a transitional bilingual program but because of the likely regression of L1 skills they will probably fail to experience any cognitive advantages in comparison to unilingual children. In a submersion program they are likely to perform below their potential for a variety of reasons considered earlier.

Children whose motivation to learn L2 is low and whose conceptual-linguistic knowledge is not conducive to the acquisi-

tion of literacy skills are likely to fail in both submersion and L2 immersion programs. Neither program seems likely to provide an educational context in which the child's initial school learning experiences would be successful and non-traumatic. This may be provided to a greater extent by a transitional program. However, only a program that attempts to promote the child's academic and cognitive development through both L1 and L2 is likely to result in a cognitively and academically beneficial form of additive bilingualism.

SUMMARY AND CONCLUSION

In the course of this paper, evidence relating to several seemingly paradoxical and contradictory findings has been reviewed. First is the question of why a home-school language switch leads to such different outcomes in majority and minority language learning situations. Second is the fact that early studies reported a negative association between bilingualism and intelligence whereas more recent studies have consistently reported a positive association. Finally, there is the lack of any simple relationship between instructional time spent through the medium of a language and achievement in that language. In bilingual programs for minority-language children, time spent through the medium of L1 appears to have no detrimental effects on the development of L2 skills while in immersion programs for majority-language children the grade level at which L1 reading instruction is introduced makes very little difference to L1 reading achievement.

The model of bilingual education that has been elaborated is designed to provide a framework within which these apparently paradoxical findings can be resolved. The core of the model is its explicit assumption that the outcomes of bilingual education can be understood only in the context of the interaction between Educational Treatments and Child Input and Process variables. If this is the case, then it carries important implications for both program planning and evaluation. For program planning it implies that educators take account of the diversity of input characteristics of their students and adopt a differentiated approach to bilingual education. Evaluations must follow a "planned variation" approach in order to find the optimum blends of Input and Treatment characteristics under different sociocultural conditions. Failure to take account of possible Input x Treatment interactions is likely to result in uninterpretable data.

Obviously, a central question for both program planning and evaluation is the extent to which different Child Input and Process variables interact with Educational Treatments to determine outcomes. Future research must determine which Input and Process variables are most relevant. It was suggested that motivational and linguistic variables might be important to consider in interaction with Educational Treatments and several hypotheses regarding these interactions were proposed as possible ways of integrating apparently inconsistent research findings. The major educational implication of these hypotheses is that if *optimal* development of a minority-language child's cognitive and academic potential is a goal, then the school program must aim to promote an additive form of bilingualism involving literacy in both L1 and L2.

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